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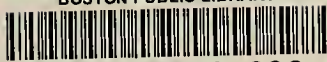
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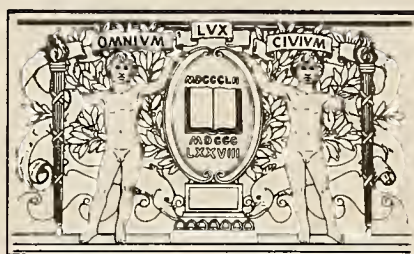
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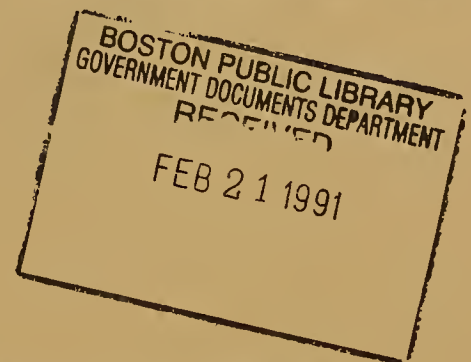
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**Boston's Economic Development Agency**



# **GROWTH IN THE NINETIES:**

## **Prospects for Strategic Economic Development in Boston**

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## A Report Issued by:

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Greater Boston Chamber of Commerce

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## EXECUTIVE SUMMARY

Boston's changing economic environment calls for a new, more strategic approach to economic development policy. No longer can we focus on supply-oriented policies which provided quality space for ever growing demand. In the face of national and regional recession, Boston must have a more aggressive posture in actively recruiting and expanding those sectors of the economy which show long term growth potential and are closely matched to Boston's competitive advantages.

Fortunately, Boston has many competitive advantages which offer the opportunity to maximize the potential of emerging growth industries and help lead the region out of recession. Boston is the economic center of the New England regional economy. Its financial institutions, port, hospitals, academic and research institutions serve the entire region. In fact, as Dr. James Howell noted in his recent study of the Boston economy, nearly three quarters of the new jobs created in Massachusetts in the 1990s will be created in the Metro Boston area.

While Boston has many competitive advantages, it is now locked in competition for national and international investment with several other major American, European, and Asian cities. Ultimately, the strength of the city's economy will depend upon the ability of its businesses to innovate and compete nationally and internationally. This is where Boston's strengths as a "knowledge based city" and its strength in key technology areas become critical.

Though Boston has key elements that give it a competitive advantage--specialized pools of skills technology, intellectual infrastructure, clusters of capable companies and suppliers, sophisticated and demanding local customers, and a climate of competition and investment--possessing these qualities does not insure future economic competitiveness and growth for the Boston area or the City of Boston proper. As other American and European cities develop their intellectual infrastructure, train their workforces, and support and attract emerging industries, Boston will have to compete for new companies and growth of existing firms.

Competing with American and European cities means aggressively recruiting new firms and supporting existing growth industries. It also means undertaking an aggressive economic development strategy. We are proposing to undertake a six step strategy.

- 1. Strengthen the regional economy by stressing regional strengths in our recruitment efforts and forming a regional public/private compact to plan regional economic growth strategies.
- 2. Develop a targeted education and skills training program to meet the changing labor force needs of emerging industries including an Academy for Vocational and Applied Technology.
- 3. Develop a comprehensive development finance strategy to fill current financing gaps, including start-up capital, venture capital, and working capital.



- 4. Create tax incentives for emerging industries including research and development tax credits currently proposed in the Competitive Cities Act of 1991.
- 5. Target specialized real estate development for emerging industries, including low-cost space and specialized incubator space which focuses on both public and private projects such as Boston State Hospital, the Marine Industrial Park, South Station, and Olmstead Plaza.
- 6. Develop a manufacturing stabilization strategy which helps traditional manufacturers with growth potential to be more competitive in the national and international markets.

The primary purpose of this study is to identify Boston's specific competitive advantages and disadvantages, identify specific growth industries and firms which are most likely to expand in or be attracted to Boston, and develop specific work plans to target these businesses. We have targeted six "industries". These are by no means the only industries in the region with bright futures. Others which already have a strong base in the region and merit serious attention include financial services, software and information technology. These were chosen because of their "fit" to Boston's clear regional and international competitive advantages, their growth potential, and their potential to provide a full range of job opportunities and career ladders for Boston residents.

**"Advanced Materials"** encompasses a number of industrial materials including advanced ceramics, engineering plastics, superconductors, fiber composites, metal matrix composites, synthetic membranes, and powder metallurgy. The industry is considered to have very high growth potential and a wide variety of commercial and industrial applications. The Boston area is a center of advanced materials R&D and the industry already has a major presence in the Eastern Massachusetts region.

**Environmental Industries** are those providing goods or services aimed at having a positive environmental impact. Examples include companies involved in solid waste management, environmental consulting, software development, recycling, hazardous waste management, air and water quality, and environmental bioscience. Due to increased consumer interest as well as recent strict federal, state, and municipal legislation calling for bans on certain products, the environmental industries are expected to have a high growth rate. Boston, with its existing track record of support for environmental industries, its strong consumer market, and its R&D infrastructure, is poised to play a major part in the growth of this industry.

**Biomedical and Health Related Industries (Research Biotechnology, Pharmaceutical, Instruments and Equipment, Software and Health Care)** have been the focus of much attention in the state and Metro-Boston and has great potential for growth. The Boston region has a strong agglomeration of institutions and private companies already active in this field. Related industries in instruments, equipment, and software provide the opportunity for a wide-ranging industry with significant employment opportunities.

**European Linkages** Boston is the closest major American city to European markets. The





changes taking place in the European economy present both challenges and opportunities for U.S. companies. Specific types of companies seeking a U.S. market may find Boston a particularly attractive location.

**Food Related Companies** have long been a small but important component of Boston's manufacturing base. Food processing was one of the few manufacturing industries to hold its own over the past several years, with employment actually increasing between 1989 and 1990. The combination of increased consumer demand for specialty foods, increased national and international demand for fresh seafood, and the large Boston restaurant and tourism industry offer opportunities for expansion of this industry.

The **Tourism Industry** is by several measures Boston's leading industry. It is also widely considered Boston and Massachusetts' largest export industry, bringing in millions of European and Asian dollars into the region each year. Employing nearly 20,000 people in hotels and related industries, tourism is clearly an area of strength in the Boston economy which, if more competitive, has tremendous opportunity for growth.

These six industrial sectors offer the promise, but not the guarantee of future economic growth for the Boston region. Capturing the promise of these industries requires a coordinated and targeted economic development and recruitment strategy. To that end, the EDIC, AIM, and the Greater Boston Chamber of Commerce will undertake the following actions to help develop the growth of these industries and attract them to the Boston region.

- We will form and staff industrial sector groups for each of the six targeted industries detailed in this report, including representatives of the industry currently located in the region.
- Each industrial sector group will further develop detailed industrial analyses begun by this study. These analyses will include current specific industry needs, industry organizations and networks and individual firms seeking to expand and/or relocate.
- For each industrial sector group we will develop a detailed two year targeting plan for active growth and recruitment.
- For each industrial sector group we will design and develop a set of marketing materials to aid in the recruitment of growing firms in that sector.





## **GROWTH IN THE NINETIES: PROSPECTS FOR STRATEGIC ECONOMIC DEVELOPMENT IN BOSTON**

Boston's economy has undergone a radical change over the past two years. While our current economic contraction has not even approached the conditions of the 1981 recession, we now face a dramatically different economic landscape than that of even eight months ago. Boston's changing economic environment calls for a new, more strategic approach to economic development policy. In the recent past, economic development policy was largely supply-oriented. With demand for development strong, city policy focussed on ensuring an adequate supply of land and buildings for development, availability of investment funds, and availability of a trained labor force. In the new environment, more attention must be paid to stimulating demand for appropriate forms of new development. This requires strategic interventions to build the city's economic base. Boston must assess the constraints it now faces and identify the opportunities for building the growth industries of tomorrow.

Thinking strategically about Boston's economic future requires understanding that the economy functions on two levels, each presenting a different set of problems and opportunities, and requiring a different set of interventions.

### **Boston and the Regional Economy**

As the largest city in New England, Boston serves the larger regional economy. Much of its downtown development--from its retail activity to its office buildings--is tied to its role as the regional core. Its financial institutions serve the entire New England region. As a port, the city also serves as a major link for regional distributors.

Given its links to the New England economy, a large portion of the economic base of the city depends upon the overall health of the region's economy. The troubles in the banking industry, the computer industry, traditional manufacturing, and defense cutbacks all translate into less demand for business services and wholesale and retail activity in Boston. A strategy for building the city's economic base must consider how to respond to these weaknesses and strengthen the city's role as the regional economic center.

As Dr. James Howell noted in his recent study of the Boston economy, the Boston area will be the primary driving force in the New England and Massachusetts economies. He predicts that of the 564,000 new jobs created in Massachusetts in the 1990's, nearly three quarters will be in the Boston metropolitan area, and over 100,000 will be in the City of Boston alone.



But, while the Metro-Boston area will likely be the engine of the regional economy, the economic future of Boston proper presents some unique challenges. Theories of competitive advantage notwithstanding, Boston proper, while clearly at the center of regional economic growth, still faces problems of locational cost factors when being considered as a firm location within the Metro area.

### **Boston and the International Economy**

In the long run, the strength of the city's economy will depend upon the ability of its businesses to innovate and compete nationally and internationally. Even firms in the service sector will need to develop national and international markets to survive. This is where Boston's strengths as a "knowledge-based city" and its strengths in key technology areas become critical. Boston possesses many of the qualities that Howell and Michael Porter have noted were the key elements to the competitive advantage of cities:

- A highly skilled, specialized labor force
- An "intellectual infrastructure" of research and educational institutions which train and employ skilled workers and entrepreneurs
- Technology transfer from these institutions to new entrepreneurial firms
- Sophisticated and aggressive investment networks
- State-of-the-art communications, transportation, and real estate infrastructure
- A high level of cultural, environmental, educational, and service amenities
- A diverse economy characterized by clusters of related and rival firms and industries that compete and exchange information
- Sophisticated local market which pushes firms to compete and innovate

Possessing these qualities does not insure future economic competitiveness and growth for the Boston area or the City of Boston itself. As other American cities and nations develop their intellectual infrastructure, train their workforces and sustain their newly emerging industries, Boston, by necessity must compete for economic investment and growth.

### **Key Components of an Economic Development Strategy for Boston**

Before we turn to specific industrial sector analyses, we will first review several key components of an overall economic development strategy for Boston. These six points are intended as strategic recommendations to maximize Boston's competitive advantages in the





regional, national and international economies.

### **Strengthening the Regional Economy**

Boston's strength lies within a regional economy. As such, it is imperative that we understand that the health of the city's economy is intricately tied to the vitality of the Boston regional economy. Our intellectual infrastructure, while substantially present within city boundaries is a regional infrastructure. The educational institutions, the research facilities, and the existing "clusters" of advanced technology firms exist within a regional economy. It is the strength of this regional economy which must be supported and promoted in order to attract and capture the growth of new industries. Within each of the industries identified in this study, key regional factors will determine their continued location and ultimate growth.

Understanding the importance of the Metro-Boston regional economy suggests several economic strategies. First, promotional efforts to attract new industries must stress the strengths of the region; its academic and research institutions, its cultural advantages, and its existing "clusters" of advanced industries. Secondly, the Metro-Boston region needs a regional public/private partnership to analyze economic trends, understand the needs of growth industries, and plan for those needs. This regional compact should address issues such as targeted employment and training programs, development of appropriate industrial locations, developing a shared legislative agenda, financing, and marketing. Thirdly, we should closely collaborate with existing regional industrial organizations in growth areas which can identify collective needs, collaborate on appropriate projects, and assist in the recruitment of new firms.

### **Developing a Targeted Education and Skills Training System**

One of the key factors in ensuring competitive advantage is a constantly upgraded skilled and trained labor force which meets the changing needs of newly emerging industries. By continually improving the education and skills of Boston's labor force, we not only improve our competitiveness, but help ensure that the benefits of economic growth are shared by our residents. Our specific strategy calls for the **creation of regional associations comprised of public, institutional, and private representatives for each of our targeted industries which can identify education and training needs and develop appropriate programs.** Among the programs recommended are:

- Pilot programs in targeted industries which develop close collaborations between private firms, institutions and the public sector to upgrade technical training and create job placement networks.
- Boston's Academy for Vocational and Applied Technology to train future workers in the newly emerging industries. The Academy would be a locus of education and training which would also include a teacher training center, and a retraining center



for workers in need of an orientation to emerging technologies.

- Competency-based curriculum and apprenticeship programs, coordinated among public schools, community-based organizations, community colleges, universities and private companies/institutions which prepare workers for entry-level positions with a continuum of upgrading at the workplace.
- The encouragement, through incentives and legislation, of employee education and career ladder programs, public school/community-based organization/industry partnerships, tuition reimbursement programs, loan forgiveness and scholarship programs.

### **Developing a Comprehensive Development Finance Strategy**

The Metro-Boston region was the original center of the venture capital industry and remains a national leader in this area. However, the contraction of private lending institutions, triggered largely by failures in real estate holdings, has opened up serious gaps in the finance networks critical to further development of new growth industries. It is incumbent upon us to analyze the existing gaps in development finance and to help arrange private, and even public solutions. Important steps to be taken include surveying growth industries to analyze financing needs; playing a brokering role between venture capital firms and emerging industries; developing collaborations between public and quasi-public financing sources to target growth industries; and helping to broker private debt capital for new industries.

### **Tax Incentives**

Newly emerging industries, often involved in research and development or early production stages, require assistance until they reach an established manufacturing stage. One method of providing such assistance is through tax incentives for research and development activities and investments. In the Competitive Cities Act of 1991, Boston has proposed two such tax incentives. The first is a tax credit for qualified research expenses and basic research payments. The second is a credit against excise tax for manufacturing companies or businesses engaged primarily in research and development.

### **Targeted Real Estate Development**

While traditional operating costs for newly emerging industries have become less of a factor for inter-regional or national locational decisions, these factors remain significant for intra-regional locational decisions or even when the city is competing with other cities with a comparable intellectual infrastructure. Boston proper continues to be perceived as an expensive place to do business, even by firms in new emerging industries. If Boston is to become a desirable location within the region for newly locating or growing firms, it needs to be competitive. A major cost component is space and the perception among emerging





industries is that Boston has limited quality industrial space which tends to be at a higher cost than space located outside of the city. This is particularly a problem in industries such as Bio-Med which have high threshold requirements for improved space.

To overcome this potential disadvantage, we will initiate several actions. We will expand our brokering role with specific industries by identifying industry specific space needs and inventorying space suitable for those industries. If real cost differentials exist within the region, we will use city-owned real estate assets such as EDIC owned industrial parks to compete. Finally, we will explore the feasibility of creating a Research and Development incubator for startup firms in emerging technical industries.

### **Developing a Manufacturing Stabilization Strategy**

While the emerging industries we are targeting are the hope of the future, Boston's existing industries are an important part of the current employment base of the city. The strength of Boston's economy has always been its diversity and balance of traditional manufacturing, high-tech, and service industries. In the face of a regional recession, stabilization of the traditional manufacturing base takes on new importance. While traditional manufacturing has declined significantly over the past decade, several important industries continue to grow or are stable enough to provide continued employment for Boston residents. The city's traditional industries--printing/publishing, textile/apparel, food processing, and fabricated metal-- provide 17,390 jobs today, 50% of the total manufacturing jobs in the City of Boston. 61 % of these jobs are held by Boston residents and 34% of these jobs pay between \$25,000 and \$39,999.

Even in the face of declining manufacturing employment, several industries have actually added to Boston's employment base. Instruments, electronics, stone/clay/glass, rubber/plastics, and chemicals created 3,000 new jobs between 1977 and 1987. These industries hire more Boston residents and minorities, while providing higher annual salaries than the average manufacturing industry. However, during the past two years, these industries have lost a considerable number of jobs and require a targeted retention strategy.

A manufacturing stabilization strategy consists of three components:

- Provision of business assistance to manufacturers including financing, location of space, and technical assistance
- Development of specialized real estate such as water-front properties for fish processors seeking to expand export markets.
- Development of targeted "Industrial Action Projects", specifically for the garment, printing and food industries. These projects, currently being developed for the garment industry, organize industry associations to develop innovations such as technological upgrades, skill upgrades for employees, and capturing high quality/high skilled work.



## **TARGETING NEW INDUSTRIES FOR BOSTON'S FUTURE**

The primary purpose of this study is to identify trends in the Boston economy, identify some of the city's key advantages and disadvantages, identify target growth industries which would strengthen Boston's economic base, and identify target companies for active recruitment and expansion. The report provides information on key targeted industries and strategies for promoting these industries in Boston. It is based upon both a review of relevant literature and extensive interviewing with individuals from private industry, academic and research facilities, relevant public agencies, and business organizations.

The targeted industries fall within three categories:

- 1. Industries which offer growth potential (biomedical/health care, advanced materials and environmental);
- 2. Economic activities which could offer growth potential if key barriers are addressed (European linkages); and
- 3. Industries which can continue to provide stable jobs for Boston residents (food processing, tourism)

It is important to review the key principles which were used to select targeted industries and some of the strategies which are relevant to all of the targeted industries.

- 1. Targets must focus on the traded sector-- those firms which export goods and services outside of the region.
- 2. Targeting must take stock of regional competitive advantages and disadvantages in the national and international context.
- 3. Targeting must take stock of the city's competitive advantages and disadvantages within the region.
- 4. Targeting must be sensitive to social and demographic changes occurring in the economy.
- 5. Targeting must reflect current world economic conditions/market competition.
- 6. Targeting must be consistent with the vision of the city's residents and the maintenance of the city's quality of life.
- 7. Targeting must account for emerging technologies affecting the types of goods and services being produced and the production and distribution process.
- 8. Targets must provide for a full range of job opportunities in terms of wages, skill levels, and opportunities for advancement for Boston residents.
- 9. The city should target a range of industries, rather than concentrate attention on just one or two sectors.



# U.S. Market for Select New Industries

SELECT INDUSTRIES	1985	1987	2000
-----	-----	-----	-----
Biomedical Technology	\$220 Million	\$600 Million	\$1.8 Billion
Structural Ceramics	\$112 Million	\$117 Million	\$1-5 Billion

Source: 1990 U.S. Industrial Outlook

# Profile of Select New Industries in Metro Boston

SELECT INDUSTRIES	# OF COMPANIES	# OF EMPLOYEES	% SHARE TO MASS. # OF FIRMS
-----	-----	-----	-----
Advanced Materials	56	51,806	21%
Biomedical Technology	130	17,585	77%
Environmental Technology	128	59,162	70%

Source: Corp. Tech Directory, 1990.  
MA Biomed Directory, 1990.  
MA EnviroTech Directory, 1990.





## **ADVANCED MATERIALS**

The term "advanced materials" encompasses a number of industrial materials: advanced ceramics, engineering plastics, superconductors, fiber composites, metal matrix composites, synthetic membranes, and powder metallurgy. Advanced materials are distinguished by one or more high performance characteristics -- high strength relative to weight, resistance to heat or corrosion, longevity, etc.

Industry growth and locational trends indicated that opportunities may exist for stimulating expansion of the advanced materials sector within the City of Boston during the next decade.

### **Justification for Targeting**

The advanced materials industry is considered to have very high growth potential. Advanced materials have a wide variety of applications in such diverse industries as automobile manufacture, aerospace, electronics, telecommunications, and medicine. Moreover, while the industry has yielded many new products and has annual U.S. sales in the billions, it is still in its infancy and promises to generate technological innovations with far greater commercial application in the future. The application of superconductors to electric power generation is but one example. Particularly robust short-term growth is forecast for ceramics, engineering plastic, and fiber composites (U.S. Industrial Outlook).

The Boston area is center of advanced materials R&D. MIT's Department of Materials Science and Engineering is considered one of the three top U.S. academic centers of scientific and engineering research and training related to advanced materials. Two U.S. Department of Defense facilities, the Army Materials Technology Laboratory in Watertown and the U.S. Army Natick Research, Development and Engineering Center, conduct large-scale materials research. Other universities, including Harvard's Division of Applied Sciences and Northeastern University's Center for Electromagnetic Research, are also involved in materials research and training. This R&D infrastructure has both attracted corporate R&D activity into the region and resulted in the spinoff of new companies.

The advanced materials industry already has a major presence in the Eastern Massachusetts region. Fortune 500 corporations such as General Electric and Textron, mid-sized Massachusetts-based firms like the Norton Company, Millipore, Cabot Corporation, and Spire, and numerous startups are involved in advanced materials R&D and manufacturing.

### **Opportunities**

The city's major opportunity for capturing a portion of the regional growth in the materials processing industry lies in capitalizing on its proximity to the industry's R&D infrastructure.





R&D at MIT, Harvard, and Northeastern is already generating commercial spinoffs by university faculty members. Some of these firms are locating in Cambridge on the Harvard-MIT axis, particularly during their R&D and prototype development stages. They locate there because many of the firms' principals and senior staff continue to maintain ties with these institutions and/or want ready access to the technical expertise that these institutions provide. Parts of Boston are located directly adjacent to or only a short distance from these institutions, offering a potentially attractive location. One advanced materials firm started by MIT graduates, American Composite Technology, has located within the city limits, in the Marine Industrial Park. Otherwise, startup advanced materials firms have generally not ventured across the Charles River.

Some major industrial corporations interested in adopting advanced materials technologies have located R&D centers on the Harvard-MIT axis. These companies, seeking to evaluate the applications and commercial feasibility of advanced materials technologies, hire university talent and/or develop liaisons with university research laboratories. Some of these centers are permanent while others are maintained only until the firm has completed a defined R&D agenda. Alcan and Nippon Steel are examples of firms that established temporary R&D centers (since closed) in Cambridge. According to a senior MIT faculty member, a number of large industrial firms, particularly Japanese firms, are currently considering opening R&D centers in the Boston area.

Some of the commercial product development stimulated by the two Department of Defense materials research facilities could also be captured by the city. The Army Materials Technology Laboratory (MTL), with its Watertown Arsenal Location, is very close to the city limits. The MTL conducts a wide range of materials research related to weapons technology. For example, a current program involves research on alternative materials for lightweight advanced armor, focusing on steel, aluminum alloys, ceramics, reinforced plastics, and composites. The MTL provides research grants to small companies through the federal Small Business Innovation Research program and also licenses technology for commercial application. Small companies which license MTL-developed materials technologies might find a location nearby the Lab convenient for working with Lab staff during the product development phase. The materials R&D conducted by the Natick Center for non-lethal military equipment -- uniforms, protective gear, shelter, and air drop equipment -- also has commercial application.

## Strategy

Given the combination of strong industry growth and the key role played by Boston area institutions as a source of brain power for materials R&D, we will consider ways in which public policy and resources can be used to direct some of the industry's regional growth into the City of Boston. We need to focus our efforts on firms with which we are in the strongest competitive position. These are likely to be startup firms in the R&D and prototype development stage (particularly those headed by MIT or other nearby university faculty), small-scale high value-added manufacturing operations, small-scale corporate R&D



centers, and engineering services.

We will pursue three basic strategies to support the location of advanced materials firms in Boston.

- 1. Market the city to new firms that are spinning off from research at local facilities,** including MIT, Northeastern, Harvard, and the two Army research labs. These firms are likely to find proximity to local research institutions attractive because of access to scientific and technical expertise. Some of the principals of these firms may also want to maintain professional positions at these institutions. The city can offer the advantage of closer proximity than many locations in the Boston region.
- 2. Market the city to major U.S. and international corporations that want to establish R&D centers in the Boston region.** Corporations that are developing products using advanced materials may wish to establish R&D centers in the Boston region to gain better access to the expertise at local research institutions. MIT, in particular, has sought to develop university/industry research partnerships in the materials processing field.
- 3. Support the region's existing advanced materials research infrastructure.** The region's attractiveness to advanced materials firms is clearly reliant on the high-level research and the skilled technical workforce being produced by area academic and research institutions. Yet, today the competition for research dollars is fiercely competitive among institutions and regions. We must work with other local jurisdictions as well as state government and the area's representatives at the federal level, to support the flow of research dollars to the region.

## **ENVIRONMENTAL INDUSTRIES**

Environmental Industries are those providing goods or services aimed at having a positive environmental impact. Examples include companies involved in solid waste management, recycling, hazardous waste management, air and water quality, and environmental bioscience.

### **Justification for Targeting**

As the result of a number of recent social and environmental trends, companies involved in a wide range of activities associated with a "clean" environment are expected to grow during the 1990s. Trends which support this assumption include:

- The large need for cleanup of a variety of hazardous waste materials, e.g., toxic chemicals, radioactive wastes, used oil;
- Passage of the new Clean Air Act by Congress, which will require a variety of new goods and services;





- Ongoing implementation of water treatment and anti-pollution activity;
- Increasing consumer interest in "green" products, or products which do not harm the environment;
- The solid waste crisis, which is leading to increased activity in waste materials recovery, processing and recycling into new products;
- Increased need for environmental negotiation services, as public necessity for handling waste and energy and the "not in my backyard" attitude increasingly collide;
- Rapidly growing interest in Eastern Europe in state-of-the-art environmental clean-up technology;
- The higher cost of oil, which once again is leading to increased consciousness about energy conservation; and new developments in environmental biotechnology, e.g., the use of microbes to reduce the sulfur content of oil to meet U.S. Environmental Protection Agency Standards.

Environmental companies are particularly attractive because their markets are driven by factors relatively unrelated to the business cycle. In other words, demand for the goods and services of these firms is a function of regulatory, political and social trends and so should rise even in the face of regional recession.

## **Opportunities**

**1. Solid Waste Recovery and Recycling.** Solid Waste recovery and recycling represents a significant economic development opportunity. From an economic development point of view, recycling involves the transformation of useless trash into valuable materials. New jobs can be generated at all points of the recycling chain: increased collection adds jobs to businesses as varied as paper haulers and oil transporters; the processing of waste materials requires jobs (i.e. materials recovery facilities); and, finally, manufacturing companies put the secondary materials to new uses developing new products and new technologies which generate jobs in the economy. Moreover, recycling is one industry in which major urban areas have a competitive advantage. For companies producing products from recycled materials, access to a large and stable source of recycled materials is a major locational factor.

Development opportunities in recycling can only be realized if the waste material is recovered in the first place. A number of actions at the city and state level are moving such a system into place. First, Mayor Raymond L. Flynn recently signed an ordinance requiring at least 20% of the city's solid waste to be recovered by 1992, with the recovery requirement increasing over time. Second, the Massachusetts Department of Environmental Protection issued regulations banning recyclable materials from Massachusetts landfills and



incinerators. Materials to be banned include tires, metals, glass, plastics, and paper. The bans go into effect on a staggered basis over the 1991-94 period. Third, the state recently issued its solid waste master plan, which sets the aim of recovering 46% of the state's solid waste stream by the year 2000. To implement the plan, the state is offering financial incentives to create privately-operated materials recycling facilities (MRFs) throughout the state, and will be actively pursuing the creation and expansion of facilities to reuse the secondary materials. The Boston Industrial Development Finance Authority is taking an active interest in seeing that tax-exempt financing can be provided for recycling industries.

In light of these circumstances, there are numerous examples of economic development opportunities in Boston associated with recycling:

- The deluge of old newspaper (ONP) in the Northeast is attracting companies interested in making paper products such as molded pulp (e.g., egg cartons), cellulose insulation, kitty litter, and mulch. New U.S. affirmative procurement guidelines make cellulose insulation the preferred insulation material for construction funded by all U.S. agencies and state and local recipients of Federal funds. The upsurge in demand for recycled printing and writing products will stimulate stability and potential expansion of production by Patriot Paper in Hyde Park, the only printing and writing mill in the Northeast dedicated to making recycled paper (financed by BIDFA). Major increases in foreign demand for high quality waste paper have the potential to mean significant increases in Boston port activity. The U.S. export of waste paper claimed 282% between 1981 and 1989 (to 6.3 million tons). Currently, Boston exports less than 5% of the volume leaving New York City.
- The nation's two major steel can detinning firms are seeking new sites near urban areas to establish cleaning and shredding operations. The processed cans will then be shipped to detinning plants south of New England.
- The "anti-environment" connotation given the plastic industry has stimulated that industry to actively seek new means of recovering and recycling plastic material. In particular, the Council of Solid Waste Solutions (a consortium of plastic resin producers) may be interested in developing a plastics recycling demonstration project in Boston. Such a project could be particularly interesting and attractive because of Boston's proximity to the Plastics Engineering Department at the University of Lowell, the oldest, largest and most highly regarded such department in the U.S. Boston could seek to utilize Lowell's expertise in developing innovative plastics recycling operations. Innovations are needed in secondary plastics separation and processing technologies, the proper reuse of secondary materials, and products using mixed plastics. This project could provide a focal point for developing Boston as a center of research in plastics recycling.
- The banning of scrap tires from state landfills means there are opportunities for reprocessing scrap tires in Boston. Opportunities include shredding scrap tires for use as industrial fuel; pulverizing tires to make crumb rubber, which can be sold to asphalt companies for use as aggregate and can be reused to make rubber doormats and tiles; tire





retreading; and products fabricated from scrap tires. U.S. affirmative procurement guidelines give preference to retreaded tires. Because Boston is the center of significant Federal activity, there is a good local market for retreaded tires.

- Businesses producing a number of innovative products using waste glass cullet could be developed. These include foam glass (e.g., soundproofing and ceiling tiles) and glass polymer composite materials (e.g., sewer pipe).

**2. Clean Air and Water.** Currently, the city and surrounding metro areas are home to a large number of national prominent consulting, engineering and manufacturing firms in the field of clean air and water. In addition, the region's universities have some of the country's leading research centers in this field. This agglomeration of highly regarded businesses and universities can be used as a draw for developing and attraction new firms to the city.

Moreover, new and existing Federal and state clean air and water legislation and regulations provide a number of economic development opportunities. The new Clean Air Act focuses on smog reduction, alternative fuels, toxic emissions, and power plant emissions. A wide variety of new products are needed for development, e.g., filters, alternate fuels such as natural gas and methanol, new environmentally safe chemicals. Moreover, a significant amount of consulting and engineering services is needed to assist U.S. industry in adhering to the new law. In addition, seventeen regions in New England and New York need to find means to reduce their smog by dates set in legislation-- significant amounts of consulting assistance will be required to aid them. As the economic center of New England, Boston could be the primary home to consulting and engineering firms that service the region. Firms already in the city form a solid base from which to build.

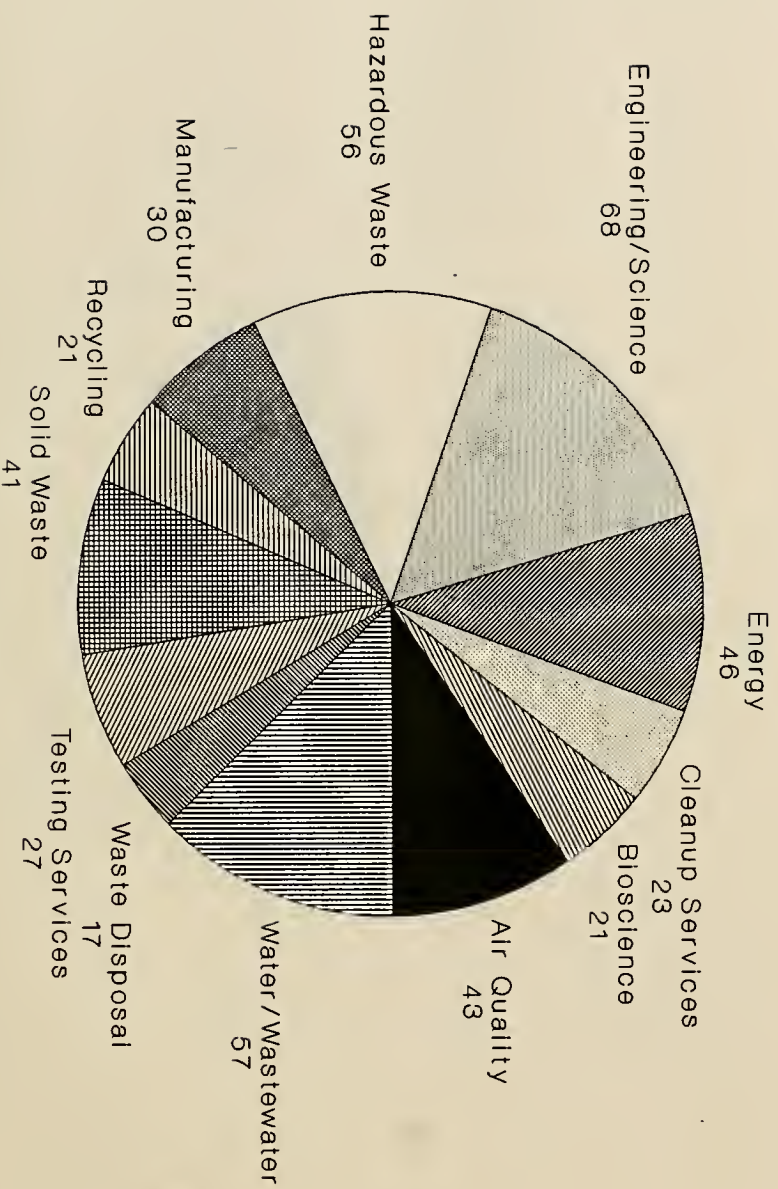
**3. Hazardous Waste.** Ongoing implementation of Federal and state hazardous waste legislation and regulations has and will continue to provide significant business opportunities in dealing with materials such as asbestos, toxic chemicals, and radioactive waste. There is room for firms which advise clients on how to deal with the materials, those which invent technical means for handling them, and those which actually handle the material. Massachusetts is home to over 75 firms involved with hazardous waste, an agglomeration which could attract others to the region.

**4. Environmental Biotechnology.** Increasingly, biotechnology is employed to solve environmental problems. One Boston firm has developed microbes which reduce the sulfur content of oil. The use of microbes in oil spills has received much publicity. Given the rich biotechnology expertise in the region, there is opportunity to attract firms in the environmental biotech field.

**5. Energy Conservation and development.** As one of the nation's leading engineering centers, metro Boston is home to a significant number of firms and universities involved in energy conservation and development. Despite short-term reprieves from the energy crisis,



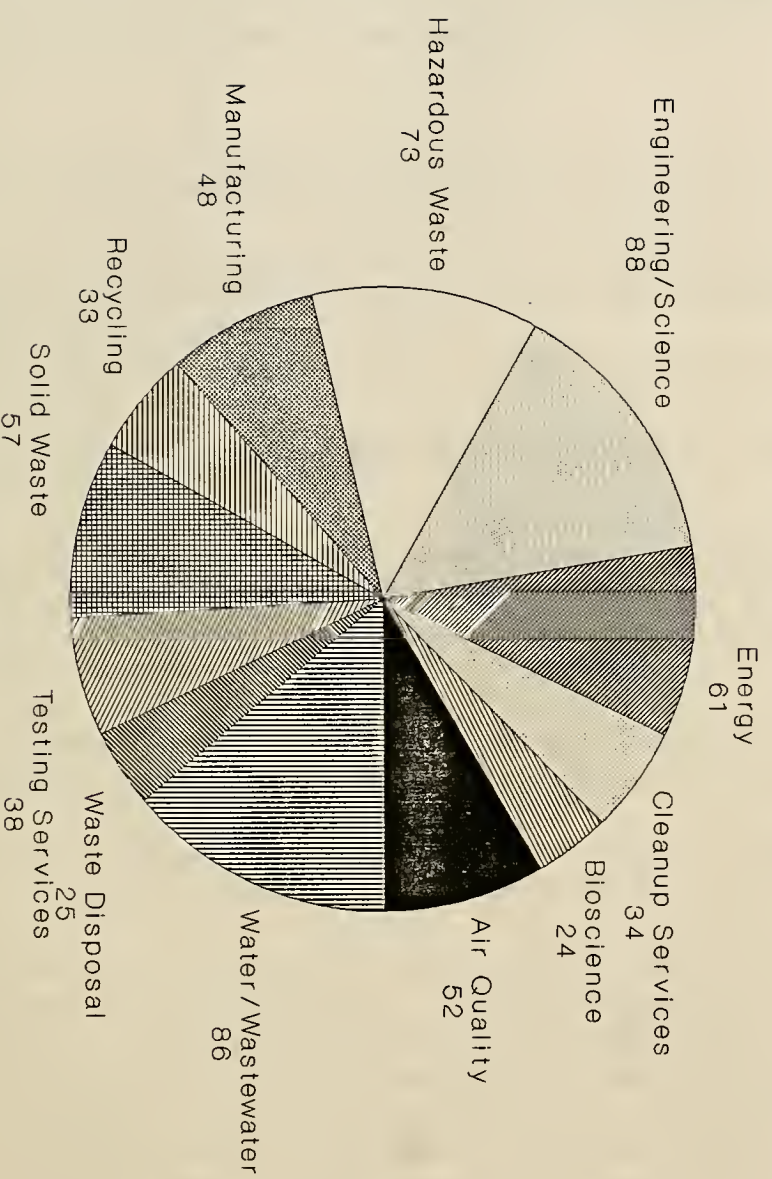
# Composition of Metro Boston's Environmental Technology Companies



Source: Dir. of Environmental Companies



# Composition of Massachusetts' Environmental Technology Companies



Source: Dir. of Environmental Companies





it is clear that over the next several decades major advances must be made in energy conservation and development -- in alternative fuels (e.g., solar and wind), and in more efficient use of traditional fuels (e.g., more efficient engines, better insulation). The existing infrastructure in the Boston area in this field can be a springboard for additional expansion.

**6. Testing Services and Laboratories.** Heightened activity in solid waste, air and water quality, hazardous waste and energy conservation has increased the need for services to test the composition and properties of certain materials. Massachusetts already is the home to forty such firms and can be a center for this "industry".

## **Strategy**

1. Recycling. To take advantage of the economic development opportunities in recycling, We will

- 1. target for recruitment a series of waste-material-using industries with potential for expansion in the Boston area--plastics, metal cans, waste paper exports, scrap tires, and mixed glass cullet;
- 2. support an affirmative procurement program in city government as a further prod to new businesses; and
- 3. prepare and implement a marketing strategy aimed at reaching a broad range of recycling industries.

2. To take advantage of the economic development opportunities in clean air, we will

- 1. target opportunities developing as a result of the Clean Air Act and
- 2. prepare and implement a marketing strategy aimed at reaching a broad range of clean air industries.

3. In other environmental fields noted above, we will undertake further analysis of opportunities coming out of legislative changes and implement similar marketing strategies.

## **BIOMEDICAL AND RELATED INDUSTRIES: RESEARCH, BIOTECHNOLOGY, PHARMACEUTICALS, INSTRUMENTS AND EQUIPMENT, SOFTWARE.**

The biomedical industry has been the focus of much attention as the state and Boston region have witnessed declines in other sectors. High hopes are being pinned on this industry to fuel the economy of the 90's and into the twenty-first century. While the Boston region does have many key competitive advantages in the biomedical sector, its success in capturing the potential economic benefits associated with the industry depends upon paying closer attention to barriers and to its competitors who are also trying to attract the industry. This study does not include the larger health care industry, obviously a major and expanding employer in the Boston region. The larger health care industry, with jobs in health care, health technicians, and various service providers raises strategy issues primarily in areas of education and training and job capture rates. An analysis of the larger health care industry and strategies to maximize employment for Boston residents is currently underway by EDIC.





## **Justification for Targeting**

The Boston region has a strong agglomeration of research institutions and private companies involved in a broad range of activities related to health care and BioMed. Boston is internationally recognized as a leader in the health care and biotechnology field.

Many health related industries, including surgical and medical instruments, surgical appliances and supplies, diagnostic substances, and electrical equipment, are among the fastest growing industries according to the U.S. Department of Commerce. For example, according to national projections, the market for products developed through genetic engineering and other biotechnology techniques is expected to grow dramatically during the 1990s. Boston is well positioned to capture a substantial portion of that market.

A recent EDIC survey of private biomed companies and institutional research facilities indicates that these companies will be providing diverse job opportunities -- from highly trained scientists to employees with a highschool diploma or equivalent.

## **Opportunities**

The anticipated expansion of a number of Massachusetts-based biomedical companies provides an opportunity for the City of Boston. The proposed development of real estate projects such as Olmstead Plaza and the South Station "Technopolis" with a health care/biomedical orientation could provide a growing perception of Boston as a center of health-related research and biomedicine.

There is some indication that companies prefer to have their manufacturing and R&D operations in close proximity to each other. This could present opportunities for the city as small companies move from the startup phase to production. Local academic institutions such as the Biotechnology Process Engineering Center at MIT have good linkages with international biotechnology companies.

Small biotechnology companies are developing strategic partnerships with large drug and pharmaceutical companies, many of which are headquartered outside of the U.S. This could potentially offer opportunities for attracting some of this foreign investment to Boston. Large German and Japanese companies are establishing biotech facilities and research and development centers in the U.S. Some of these companies are in the pharmaceutical industry, while others are large companies looking to diversify into biotechnology. German and other pharmaceutical firms are looking seriously at North American locations to help avoid what they perceive as a difficult regulatory environment in their own country. For example, Nissan Foods recently established the Nissan Molecular Biology Institute, headed by a Harvard research scientist, in the Fenway area.

There are a number of opportunities in software related to the medical industry --



particularly in the area of imaging.

## Strategy

In developing a strategy for the biomedical industry, we need to distinguish between locating jobs in the city and access to jobs for Boston residents. If Boston residents are trained in occupations relevant to the biomedical industry, they should have little problem in accessing jobs in Cambridge or other surrounding communities. The expansion of the biomedical industry in the Boston metropolitan region has significant economic spinoffs for the city. In addition to the direct jobs created in the industry, further growth of the sector will create related service jobs which are most likely to be located in the city proper. Thus, we should perceive our major competitor in the biomedical industry not as Cambridge, but cities such as Baltimore, San Francisco, or Tokyo.

Given the orientation, our strategy to promote the biomedical industry should have three key components.

**1. We will seek to attract to Boston new research and development facilities and manufacturing facilities of companies which are currently headquartered outside of the Boston metro region.** The focus of our efforts to attract investment in biomedical-related industry will be on those companies and/or institutions which are not already in the Boston region. It is critical that the Boston region capture the expansion activity of regional biomedical firms. And, if possible, it would be beneficial for the city if some of this expansion activity occurred within the city's borders. However, the city gains a lot more from the successful attraction of a large Midwestern based pharmaceutical company opening a new research and development facility or manufacturing facility, than from the relocation of a company from Cambridge to Boston.

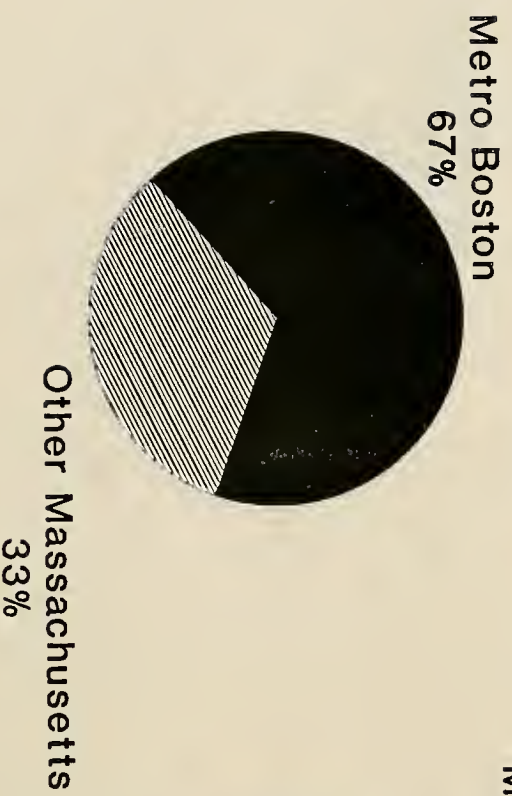
**2. We will work to develop a comprehensive biomedical education and training program for Boston residents which would prepare them for jobs in the industry even if these jobs are located outside of the city.** The ability to attract companies in the biomedical field will increasingly depend upon the industry's perceptions of the local labor force. While the Boston area has clear advantages in terms of highly-skilled scientists, the advantages of its labor force for firms in the production phase of development is more problematic. While efforts have been made to develop a more specific agenda for training in the biomedical field, a more comprehensive effort, with significant private sector participation is called for.

**3. We will help facilitate and encourage continued entrepreneurial activity.** Most of the economic activity in the biomedical industry will develop from entrepreneurial activity in the research institutions and businesses already located in the Boston region. It is through spin-off activity and the expansion of existing operations that most of the economic growth associated with the biomedical industry will occur. It

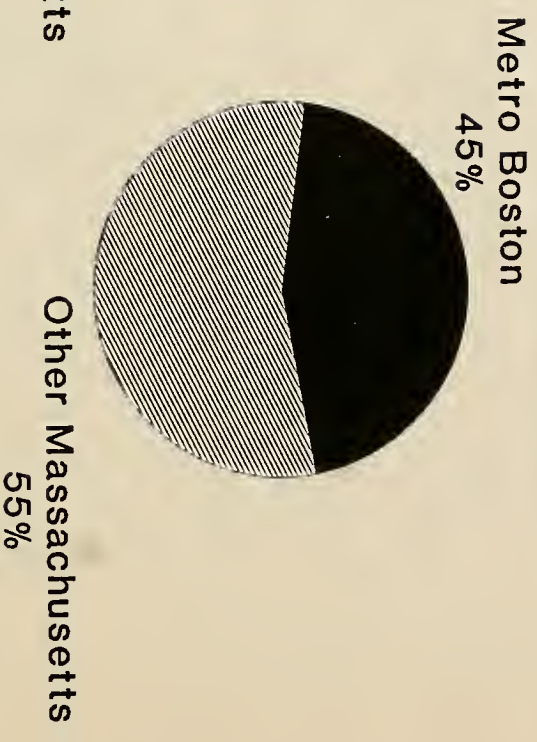


# Biomedical Related Industries Employment Shares, 1990

## Medical Instruments/Supplies



## Pharmaceuticals

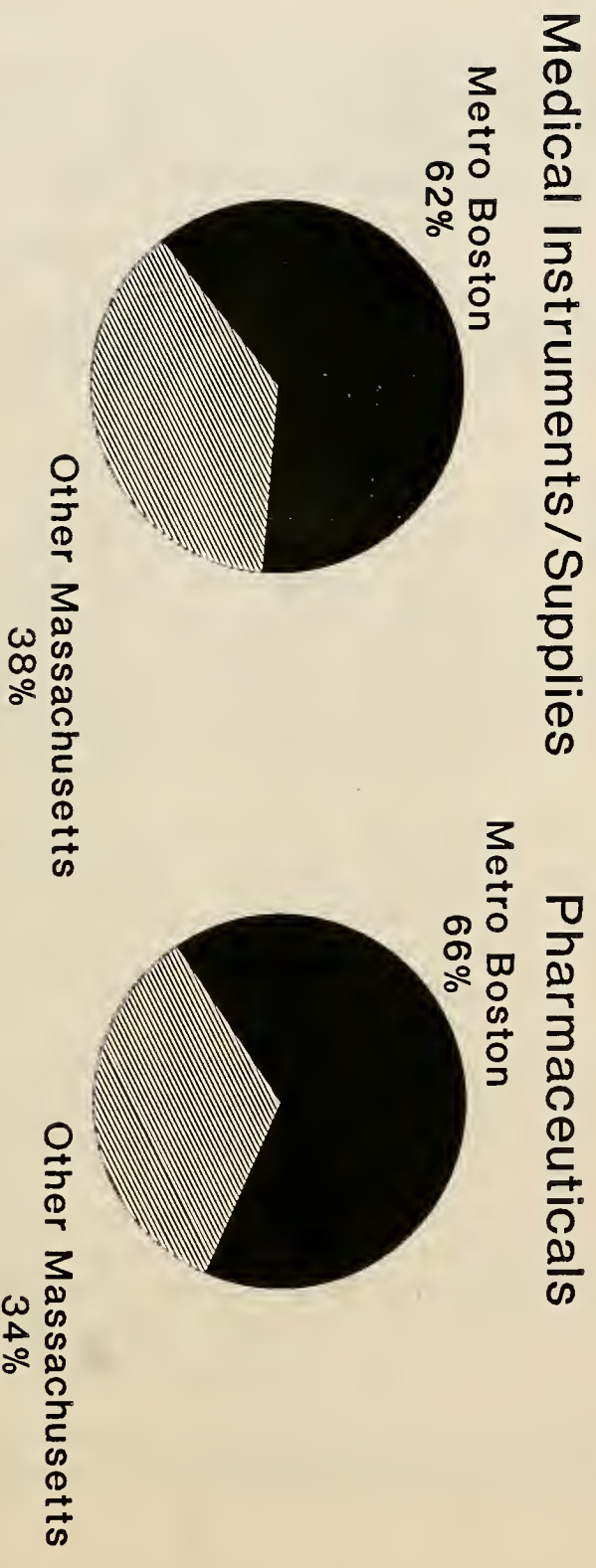








# Biomedical Related Industries Firms' Shares, 1990





is thus critical that the city maintain and build an entrepreneurial environment which nurtures the development of new enterprises in biomedical field.

## **EUROPEAN LINKAGES**

Boston is the closest major American city to European markets. The changes taking place in the European economy present both challenges and opportunities for U.S. companies. Specific types of European companies may find Boston a particularly attractive location. A strategy could be developed to target and support these specific companies.

### **Justification for Targeting**

As the world economy is increasingly internationalized, it is important to look beyond the U.S. borders for sources of direct business opportunities.

### **Opportunities**

The Boston region's highly educated labor force represents a locational incentive for European companies involved in technical research and complex, high-technology manufacturing. The location for internationally known universities and the large pool of technical workers in the state's high-technology industry is an asset recognized by European companies. The current downturn may make this advantage more significant. For example, a British-owned computer maker has just opened a facility in Waltham. According to the company's president, the current economic downturn creates a growing pool of available high-tech workers.

European enterprises cannot afford to build their own research and development facilities in the U.S. Access to existing research facilities is a strong advantage to a Boston location for small technology-intensive companies. For example, a Swiss medical products company located in the Boston region due to the presence of hospital research centers and medical institutions with international reputations.

European companies in the health care and computer industries require close proximity to a pool of suppliers and subcontractors. The agglomeration of companies in technology intensive-industries is a further opportunity for European companies.

The international consulting industry represents a clear advantage for the Boston area. Boston is the home to a number of consulting firms in management and technical areas (Bain, Arthur D. Little, McKinsey) which are well known in Europe. These firms have important contracts with European companies and could potentially provide important links to Europe.

The proximity of Boston to Europe provides a potential opportunity for American companies seeking to expand exporting to Europe and European companies seeking



a U.S. location. The 5 or 6 hour time difference between Europe and Boston is more manageable than the 8 or 9 hour time difference for the West Coast location. Moreover, telephone communications during business hours are easier for the East Coast. The availability of good air transportation, adequate shipping facilities, and good highway transportation combines to provide opportunities for the Boston area. The manager of a French distributor of sporting equipment noted that the ease of transportation was a decisive factor in its decision to locate in the region. The export manager for a large U.S. company operation in Boston argued that Boston is an ideal location for overseas shipping, "offering the option to use any of the three ports -- Boston, New York, or Montreal -- all within easy access."

Boston's positive image as a livable city which is somewhat "Europeanized" provides further opportunities for developing European linkages. According to European professionals, Boston has a European "flair" that no other U.S. city has. It is perceived as welcoming European consumer goods. This might present opportunities for European companies seeking a site for distribution to serve the North American market.

## **Strategy**

**1. We will target European companies in key sectors for attraction to Boston.** The key sectors which should be targeted are complex technical manufacturing: electronic components, computer software and hardware, new and advanced materials, pharmaceutical, biotechnology companies, and medical equipment companies.

Our targeting should include a marketing program oriented towards European companies. This program would include developing marketing materials oriented towards the European community and identifying appropriate avenues for marketing the materials (i.e. European-American Chambers of Commerce and the American Chamber of Commerce in Europe).

It should also include efforts to attract liaisons from foreign business associations to the city. These representatives are: European commercial attaches, chambers of commerce, business associations (e.g. German American Club). All represent key networks to reach potential European companies. They should also serve to better inform European companies about the competitive advantages of the Boston region.

We will work with local liaisons to run business seminars of interest to European companies located in the region. Such an effort would improve linkages between foreign businesses and the city.

**2. We will explore developing a facility oriented towards European companies seeking distribution sites and companies seeking to establish small research and development facilities.** This would involve undertaking a feasibility study for a multi-tenant state-of-the-





art distribution and/or R&D facility for European companies. Based upon interviews, European firms involved in sports-related industries, fashion and food and beverages would be the most likely targets. In terms of distribution, the facility could offer European companies the dual advantages of shared services and automation. There are a number of models of multi-tenant distribution oriented parks. In the Seattle area the Aldarra Distribution Facility was built in the Southcenter Corporate Park to serve multi-tenant users. At present, a very large (500,000 square feet) multi-tenant distribution facility is being built in Shreveport, Louisiana. To take advantage of the interest of European companies in breaking into the U.S. market without operating a full manufacturing operation, a facility, American Sales Center in Exton, Pennsylvania, was built as the first shared-service office and warehouse center in the U.S. oriented towards European companies. The 18,000 sq. ft. facility offers overseas and domestic clients full warehouse facilities including shipping, receiving and storage and a full range of administrative, marketing and sales support. The facility has been attracting small and medium sized British companies and is planning to add 400,000. sq. ft. of space.

Research and development facilities are another area in which European companies may wish to make an entry into the U.S. market without a full manufacturing facility. A facility with good access to the universities and hospitals which has some type of joint services may be seen attractive to European companies in the biomedical, advanced materials, or computer fields.

**3. We will plan a regional business and public sector working group which should investigate how to improve exporting activities out of the Port of Boston.** There seems to be a general consensus that business perceive there to be competitive disadvantages associated with shipping out of the Port of Boston. This perception could pose a serious barrier to further export and import activity in the city. The city should lead an effort which seeks to identify opportunities for addressing some of the problems associated with local shipping activity.

## **FOOD RELATED COMPANIES**

While food-related industries are not a major source of jobs in Boston, they currently provide some diversity in the types of job opportunities available to Boston residents and have significant growth potential. Strategies should be designed which seek to strengthen this industry in the city.

### **Justification for Targeting**

Food processing and food-related industries have long been an important component to Boston's manufacturing base. In 1989, the 2,511 employees in food processing represented about 8% of the manufacturing jobs in the city. However, this understates the impact of the industry since a large number of jobs in wholesale trade and distribution are also related to food.



In the Boston PMSA, food processing was one of the few manufacturing industries to hold its own over the last year with employment actually increasing between 8/89 and 8/90.

Unlike many other industries in the city, food-related activities provide a range of jobs for Boston residents. A survey of food processing and printing jobs in the South Boston industrial area in 1987 found that the average annual wage in fish industry jobs was \$25,066, that Boston residents occupy 36% of the jobs, and that minorities comprise 18% of the jobs.

A number of firms in the food processing industry export their goods overseas. EDIC's Boston Manufactures Universe survey found that a relatively large number of the Boston Manufacturers which export their products overseas are in the food industry. Products exported include seafood products, chocolates, beer, and sweeteners.

## Opportunities

Changing consumer buying habits and demographic trends have led to a rapid increase in the specialty food industry.

Boston's seafood industry has an international reputation -- increases in exporting could strengthen the industry.

The large restaurant and tourism industry in the city could provide additional opportunities for new products or existing products in the food industry.

## Strategies

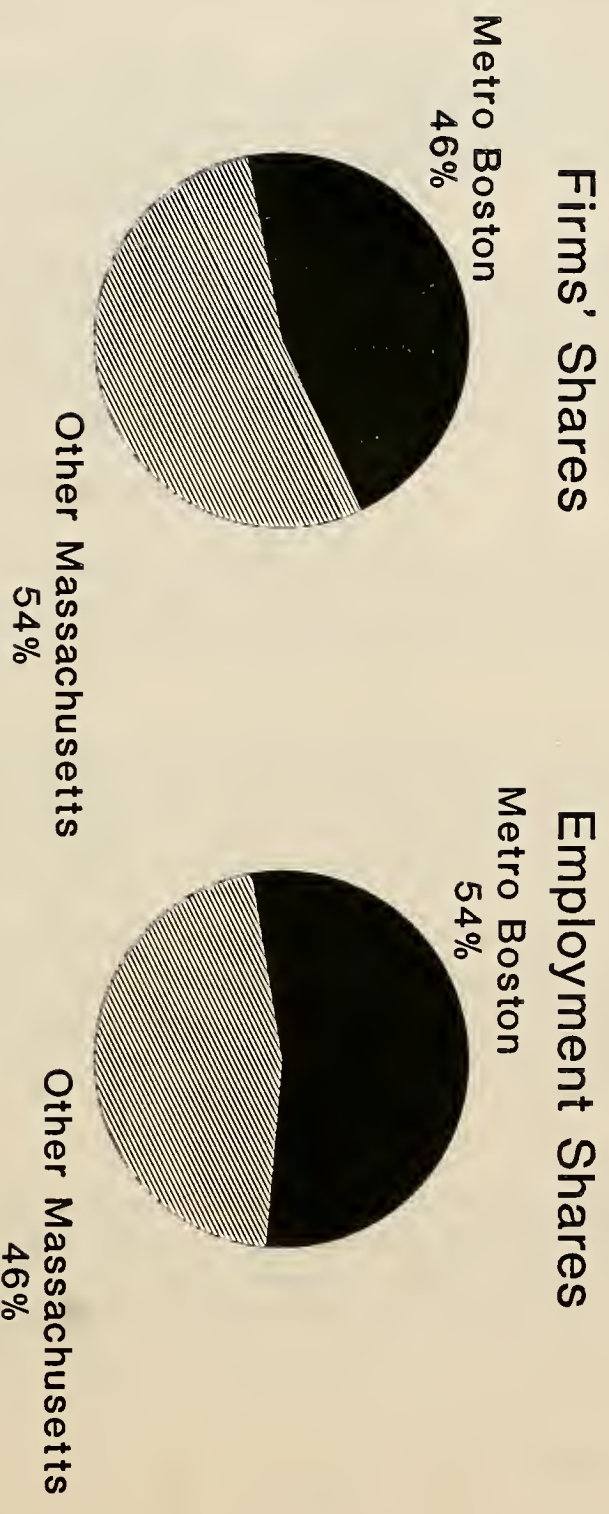
**1. Promoting cooperative relationships in the food-related industry.** Meetings could be organized for food product manufacturers, distributors and wholesalers, retailers, and restaurants leading to the establishment of a Boston Food Products Association. A similar group was convened in Western Massachusetts and currently has close to 90 members. The primary objective of the Association would be to strengthen food industry business and their share in the market by providing technical assistance in individual businesses, linkages between related businesses, and an industry as a whole in the eyes of both producers and consumers.

The services and activities of the Association could include.

**Promoting networking within the industry..** For example, a juice maker in Easthampton was introduced through the Western Massachusetts Food Industry



# Food Processing Industry Firms' and Employment Shares, 1990







Association to a farmer in Hadley and now they are cooperating on making juice.

**Providing technical assistance to industry.** The Association could sponsor workshops of general interest in the industry -- i.e. workshops in packaging, marketing, and international trade.

**Publishing a products directory.** A directory could contain product information on each good or service produced by a member business. The directory could be distributed to brokers and distributors throughout New England and could be an important marketing tool.

**Special promotion and trade show.** The Association could serve as a facilitator and organization for member businesses for special industry promotions and trade shows, such as the New York Gourmet Show, the Eastern States Exposition, the National Association of State Departments of Agriculture Exhibit, etc. Member businesses would be able to take advantage of these market opportunities at a discount.

## **TOURISM AND CONVENTION INDUSTRY**

By several measures, tourism is Boston's leading industry. International tourism, one of the leading exports in the Commonwealth, brings in more than \$1.5 billion annually into the Massachusetts economy, a substantial portion of which comes directly into the Boston economy.

Tourism and convention expenditures in Boston translate directly into Boston jobs. Over 20,000 are employed in tourism and convention and related businesses. While the majority of these positions are within the hotel industry, substantial positions exist within the restaurant/catering industries, retail trade, transportation, cultural and service sectors.

While tourism and the convention trade continue to be major contributors to the Boston economy, the city continues to miss opportunities for growth at a time when competition for domestic and international tourism is at a record level. In total visitor volume, Boston ranked only twelfth nationally, with only one sixth of the visitor volume of Los Angeles. In total delegate volume, Boston is ranked eleventh with only one-third of New York's volume.

However, Boston does have several competitive advantages which offers the potential for significant growth in this industry. Boston holds the top national position (tied with San Francisco) with the upper scale professional visitor, seeking a rich cultural experience. In several fields key to visitor volume--education, sports, history, medicine, and finance--Boston competes nationally.



## Strategies

As tourism continues to grow in importance for local and regional economies, competition both domestically and internationally will be intense. To both compete for greater market share and take full advantage of Boston's assets, several strategic steps should be taken.

1. We will need to work closely with the tourism industry to undertake a thorough marketing and strategy analysis for the industry. This analysis will need to focus on how to maximize Boston's advantages, understanding Boston's national and international competition, and what cooperative industry initiatives can be taken to upgrade tourist technology, marketing, and service provision.
2. A public/private initiative should be undertaken to identify Boston's weaknesses in servicing tourists and conventioners (promotional material, signs, maps, transportation, visitors centers, coordinated housing access etc.) and to develop improvements in these areas.
3. Increasingly, tourism is a regional industry. We should work with the Boston tourism industry and establish close links to other major actors in the region to develop cooperative marketing, services, and strategies.

## CONCLUSION

Boston's regional economy faces many significant challenges. A severe lack of credit, a regional recession, and a state fiscal crisis put new demands upon the private and public sectors to develop innovative methods to continue economic growth. Encouraging continued economic growth in our existing industries such as health care, software, and telecommunications among others through shared legislative, employment and training, and financing initiatives will be critical to continued job growth over the next decade. But, at the same time, we need to move beyond these successful industries to help ensure that Boston and the region achieve the maximum benefits from the growth of newly emerging industries.

We have chosen to target three newly emerging industries that closely "fit" with Boston and the region's competitive advantages: Advanced Materials, Environmental Industries, and BioMedical Industries. In addition to these three, we will focus attention on three existing "industries": food processing, tourism, and European linkages which have the potential to grow significantly over the next decade.

Over the next year, our organizations will undertake a four part program to target the three emerging industries for location and expansion in Boston and its region. This program will include the following elements:



- We will establish industry roundtables for each of the three emerging industries, and their sub-industries as necessary, to fully understand the needs of the industry and the prospects for capturing new growth for Boston.
- We will more closely research each industry by carefully surveying the regional industrial infrastructure existing in universities, research institutions, and industry organizations.
- Utilizing our research, we will develop targeted marketing materials aimed at recruiting growing firms which might locate in Boston and the region.
- We will explore creative real-estate and financing solutions which can be packaged for growth industries and specific firms.
- Over the next year we will contact potential firms in these and related industries through mailings, phone follow-ups and direct visits. These firms will be provided with appropriate materials and follow-up contacts with local industry leaders and public officials.

Aggressive targeted recruitment of emerging industries represents Boston and the region's best hope for a faster, but long-term recovery from the current economic down-turn. By building on Boston's clear competitive advantages, our existing infrastructure, and the close working partnership of the public and private sectors, we greatly increase our chances to capture the economic growth of the 1990's.





BIOMEDICAL COMPANIES  
CITY OF BOSTON

COMPANY	# OF EMPLOYEES	PRODUCT CATEGORY
Biopure Corporation	50	Therapeutics
Endogen Inc.	18	Laboratory, diagnostics, therapeutics, chemicals
Harbor Medical Devices Inc.	4	Medical/ surgical products
Immunotech Corporation	25	Diagnostics
Keane Inc.	800	Laboratory
Orion Research Inc.	240	Laboratory
SDK Healthcare Information Systems	100	Medical systems

Source: MA Biomed. Directory, 1990.  
EDIC, BMU database.

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ENVIRONMENTAL TECHNOLOGY COMPANIES  
CITY OF BOSTON

COMPANY	# OF EMPLOYEES	CATEGORY
Air Purolator Corporation	15	Air, manufacturing
Anderson-Nichols & Co. Inc.	141	Solid waste management, water/wastewater
BALCO Inc.	400	Energy management
Bard, Rao & Athanas Consul. Engineers	100	Air, bioscience, engineering/science, manufacturing, testing services, water/wastewater
Boston Edison	4500	Energy management
CH2M Hill	50	Energy management, engineering/science, hazardous waste management, solid waste management, water/wastewater
Charles River Associates	400	Energy management
Charles T. Main, Inc.	1400	Air, bioscience, cleanup services, hazardous waste, solid waste, water/wastewater
Chem Cycle Corporation	30	Air, cleanup services, engineering/sciences, hazardous waste, recycling, solid waste, water/wastewater
Clear Air Control Corp.	22	Cleanup services, hazardous waste, recycling, waste disposal
Dames & Moore	2500	Air, bioscience, engineering/science, hazardous waste, solid waste, water/wastewater
Daylor Consulting Group, Inc.	24	Cleanup services, engineering/science, hazardous waste, solid waste, waste disposal, water/wastewater
Earthworm Inc.	7	Recycling
Edward and Kelley	50	Engineering/science
Energy Investment Inc.	25	Energy, engineering/science
ERM, New England Inc.	27	Cleanup services, engineering/science, hazardous waste, solid waste, waste disposal, water/wastewater



COMPANY	# OF EMPLOYEES	CATEGORY
Fair Share Development Corp.	31	Air, energy, testing services, water/wastewater
Goldman Engineering	4	Air, energy
Hygienetics Inc.	300	Air, engineering/science, hazardous waste, testing services, water/wastewater
J. Makowski Co.	80	Energy
Meridian Power Corp.	5	Energy
Pequod Associates Inc.	15	Energy, engineering/science, water/wastewater
Rackemann Environmental Services Inc.	3	Air, hazardous waste, solid waste, water/wastewater
Recycling Services Inc.	3	Recycling
Shooshanian Engineering Assoc. Inc.	120	Engineering/science
Stone & Webster Engineering Corp.	6000	Air, energy, engineering/science, hazardous waste, solid waste, water/wastewater
Storch Associates	250	Engineering/science, hazardous waste, solid waste, water/wastewater
Technical Development Co.	11	Energy
Tellus Institute Inc.	55	Air, energy, hazardous waste, solid waste
The BSC Group	110	Engineering/science
United Engineers & Constructors	6000	Air, engineering/science, hazardous waste, testing services

Source: EnviroTech Directory, 1990.





ADVANCED MATERIALS COMPANIES  
CITY OF BOSTON

COMPANY	# OF EMPLOYEES
Ulysses Inc.	50
Cabot Corp./Special Blacks Division	5250
American Composites Technology Inc.	12
Arthur Blank & co.	155

Source: Corp. Tech Directory, 1990. .









